

Information Technology and Software

## Directed Design of Experiments for Probability of Detection Software

Validating probability of detection capability of  
nondestructive evaluation (NDE) systems

NASA's Langley Research Center has developed new software that enables users of critical inspections systems to validate the capability of the inspection system. Traditionally, inspection systems are validated using various methodologies to determine probability of detection (POD). One widely accepted metric of an adequate inspection system is that there is 95% confidence that the POD is greater than 90% (90/95 POD). Directed Design of Experiments for Probability of Detection (DOEPOD) is a user-friendly software package that enables detailed analysis of 90/95 POD or at any specified confidence level. Although it was designed to validate the capability of inspection systems to find fracture-critical flaws in materials, DOEPOD can be applied to systems to locate any type of flaw as well as to validate the detection capability of personnel. DOEPOD can also be employed as the core of an NDE system and provide accurate on-demand validation of the inspection system.

### BENEFITS

- ➔ True validation of NDE systems and their ability to detect flaws of certain sizes
- ➔ Applicable to both automated and manual inspection systems, personnel inspections systems, and any combination of the two
- ➔ Usable in any inspection system with capability to detect virtually any kind of flaw, including flaws registered digitally; by length, volume, diameter, grey scale or color intensity; or by combination of any criteria
- ➔ Quantitative basis for comparing inspection capabilities of different inspection systems
- ➔ Able to determine capability of finding flaws at any desired POD and confidence limit
- ➔ Capable of evaluating false call rates for both linear and area inspection windows
- ➔ Capable of validating the connection between DOEPOD POD results and other POD results from previous testing

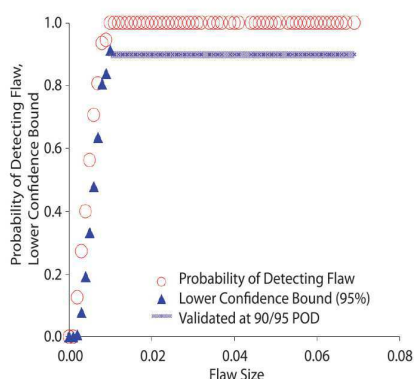
technology solution



## THE TECHNOLOGY

The DOEPOD software package can validate the capability of inspection systems to find fracture-critical flaws in materials, components, and systems, and for qualifying personnel. DOEPOD provides an accurate methodology that yields observed POD and confidence bounds for both Hit/Miss and signal amplitude testing. The software uses the concept of Point Estimate Probability of a Hit (POH) at any flaw size. POH defines the number of hits observed per set of specimens exhibiting flaws of similar characteristics. The estimated POH determined by DOEPOD at any selected flaw size is a measured or observed quantitative value between zero and one, and knowledge of the estimated POH yields a quantitative measure of the lower confidence bound. In DOEPOD, flaw size is referred to as class length. Flaws are defined as digital, analog, diameter, volume, length, depth, color intensity, grey scale, or by a combination of criteria such as total mass. DOEPOD incorporates these features into a user-friendly software that is easily integratable into any NDE. Today, almost universally, NDE systems are validated by predictive methods, which do not follow a single standard and vary widely in their results. DOEPOD provides an advance in inspection system validation because the software can prove that an inspection system is capable of finding flaws without relying on predictive math models. The software is not limited to inspection data, and may be applied to determine Probability of Success (POS) for commercial and military logistics, industrial engineering, consumer product acceptance, education testing levels, and more.

Validating Capability of Systems & Inspectors



Data generated by DOEPOD in the validation of an NDE system

Examples of inspection systems or personnel inspections that can be validated using DOEPOD

## APPLICATIONS

The technology has several potential applications:

- ➔ DOEPOD is appropriate for validation of any inspection system, including:
- ➔ Industrial inspection
- ➔ Materials inspection
- ➔ Medical imaging
- ➔ Qualification of personnel conducting inspections
- ➔ Probability of success in supply logistics, education, and consumer products

## PUBLICATIONS

Patent No: 8,108,178

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NP-2014-08-1115-HQ

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LAR-17656-1

